## REMARKS

The Final Office Action dated June 2, 2005, and the Advisory Action and Notice of Non-Compliant Amendment dated August 31, 2005, have been received and reviewed.

Claims 1-4, 7-11, 14-16, and 20-32 are currently pending and under consideration in the above-referenced application, each standing rejected.

Reconsideration of the above-referenced application is respectfully requested.

### 35 U.S.C. § 112 Claim Rejections

Claims 1, 7, and 14 stand rejected under 35 U.S.C. § 112, second paragraph, for reciting subject matter which is purportedly indefinite. Specifically, each of these claims has been rejected for reciting the term "gradually," as it applies to the acceleration of the rate at which a substrate is spun during spin coating processes.

With respect to determining whether relative terms, such as "gradually" are definite, M.P.E.P. § 2173.05(b) provides the following guidance:

> When a term of degree is presented in a claim, first a determination is made as to whether the specification provides some standard for measuring that degree. If it does not, a determination is made as to whether one of ordinary skill in the art, in view of the prior art and the status of the art, would be nevertheless reasonably apprised of the scope of the invention.

In view of this guidance, it is clear that even if the specification of the above-referenced application does not define the term "gradual," a determination can still be made as to whether one of ordinary skill in the art would nevertheless be reasonably apprised of the scope of the invention.

While it has been concluded that the specification of the above-referenced application does not provide some standard for measuring the degree of the relative term "gradually," when used to describe the transition rates and times during which the spinning speed of a substrate is increased or decreased, the understanding of those of ordinary skill in the art has been grossly underestimated.

The third edition of the American Heritage College Dictionary (1997, Houghton Mifflin Company) defines the term "gradual" as "[a]dvancing or progressing by regular or continuous degrees." In view of this definition, it is respectfully submitted that the term "gradually" is a relative term, which is acceptable if one of ordinary skill in the art would readily understand its meaning in light of the specification. *See* M.P.E.P. § 2173.05(b). The specification of the above-referenced application provides exemplary durations, or dwell times, for each spinning speed set forth therein, as well as the absolute values of those spinning speeds. By comparing the dwell times at a particular spinning speed, the transition times between rotational speeds, and the absolute spinning speed values that are described in the prior art (*see, e.g.,* U.S. Patent 6,117,486 to Yoshihara (hereinafter "Yoshihara"), Wolf, Stanley, Silicon Processing for the VLSI Era, Volume 1: Process Technology (1984) (hereinafter "Wolf"), and U.S. Patent 5,405,813 to Rodrigues (hereinafter "Rodrigues")) the above-referenced specification provides one of skill in the art with a clear understanding as to what is meant by the term "gradually," as that term is used in claims 1, 7, and 14.

Conventionally, the acceleration and deceleration of wafers during spin coating processes have been performed "as quickly as is practical to the final spin speed." Wolf, page 431. This is because "[h]igh ramping rates have been shown to yield better film uniformities than low ramping rates." *Id.* Wolf teaches a three stage process: (a) dispensing the resist solution on either a non-spinning wafer or a wafer spinning at low speed (e.g. 200 rpm for 1 sec), (b) accelerating the wafer at 20,000 rpm/sec to a final spin speed in the 3,000 to 7,000 rpm range, and (c) spinning the wafer at the final speed for 20-30 seconds to form and dry the resist film. *Id.* Assuming a median final spin speed of 4,500 rpm, the time taken to accelerate the wafer is 0.22 seconds. This reference gives someone with skill in the art an initial idea of the relationship between the dwell times and the transition times of spin coating processes. More specifically, Wolf provides one of ordinary skill in the art with a clear understanding of the meaning of rotational acceleration that is "as quickly as is practical" and, conversely, of acceleration that is not "gradual."

U.S. Patent 6,117,486 to Yoshihara (hereinafter "Yoshihara"), on which the Office relies for several of the claim rejections that have been presented in the above-referenced application,

notes that in conventional spin coating processes, in which rotational acceleration and deceleration are effected "as quickly as is practical" (*see* Wolf), rotational acceleration and deceleration may be effected at about 10,000 rpm/sec. Col. 10, lines 16-52. Yoshihara also instructs that, in the processes described therein, even quicker deceleration (*e.g.*, at about 30,000 rpm/sec) may be desirable and practical. Col. 12, line 54, to col. 13, line 15; col. 14, lines 28-42. Yoshihara teaches a multi-stage spin coating process designed to reduce the occurrence of ripples, which tend to become set into the resist film. This process has a number of dwell stages followed by transition stages which can be analyzed in a manner similar to Wolf. For example, Yoshihara describes a thinner dispense stage 2.5 seconds in duration at a spin speed of 2000 rpm, followed by a 10,000 rpm/sec transition from 2,000 rpm to 4,500 rpm (0.25 sec). Col. 9, lines 54-62. Next, Yoshihara describes a resist dispense stage of 2.0 seconds at 4,500 rpm, followed by a 30,000 rpm/sec "drastic" transition stage to 2,000 rpm (0.08 sec). *Id.* Finally, Yoshihara describes a ripple leveling stage of 1.0 seconds at 2,000 rpm, followed by a 10,000 rpm/sec transition stage to 3,000 rpm (0.10 sec) where the excess resist is shaken off and remaining layer is dried. *Id.*

Were one skilled in the art to look at the similar methods of Yoshihara and Wolf, and likewise read the specification or chapter text, one skilled in the art would understand that the high spinning speeds (2,000–7,000 rpm), the short dwell times (1–3 sec), and the very quick accelerations and decelerations (0.08-0.25 seconds) together indicate that that these manufacturing methods are optimized to apply an optically-uniform spin coating to a semiconductor wafer as quickly as possible, to the possible detriment of other factors such as the excess waste of resist material.

If one of ordinary skill in the art were then to look at U.S. Patent 5,405,813 to Rodrigues (hereinafter "Rodrigues"), one would recognize a similar yet distinct process. In contrast to the "as quickly as possible" transition times of 0.08-0.25 seconds of Wolf and Yoshihara, Rodrigues teaches a method where the resist is "very slowly" disposed on a wafer during a deceleration stage lasting up to 28 seconds ((4500 rpm – 250 rpm)/150 rpm/sec). Col. 5, lines 10-36. This phase is immediately followed by a moderate acceleration phase with a duration of about 5 seconds ((1,500 rpm – 250 rpm)/250 rpm/sec). Col. 6, lines 13-24. These transition times are an

order of magnitude or two longer in duration than the transition times specified in Wolf and Yoshihara, and are designed for the express purpose of minimizing the excessive amount of photoresist which is sloughed off and discarded. Col. 5, lines 56-58. One of ordinary skill in the art would easily recognize that the longer transition times and lower spin speeds in the dispensing and spreading phases were a trade-off between high manufacturing throughput and savings on the amount of photoresist material which had to be purchased. Col. 5, line 66 to col. 6, line 12. Furthermore, once the resist has been applied and spread over the wafer and it is no longer important to keep the dynamic forces low, the method of Rodrigues reverts to the standard pattern of Wolf and Yoshihara during the final acceleration to the drying spin speed, which transition takes place in just 0.7 seconds ((5,000 rpm – 1,500 rpm)/5,000 rpm/sec). Col. 6, lines 50-56. One of ordinary skill in the art would instantly recognize from Rodrigues that low spin speeds and long transition times of 5 seconds or greater are required when the method demands low dynamic forces on the photoresist. One of ordinary skill in the art would also recognize from Yoshihara and Wolf that rapid transitions of 0.25 seconds or less can be used to control the film profile, and that high spin speeds better dry the photoresist after it has been spread evenly over the wafer.

One of ordinary skill in the art would reasonably be apprised of the scope of each of claims 1, 7, and 14 by looking at the nonlimiting examples of absolute spinning speeds and corresponding dwell stages (*see* paragraph **[0041]**), the time duration of the dwell stages (*see* paragraph **[0041]**), and the overall focus of the invention to minimize the dynamic forces on the wafer to prevent mask material from migrating out of the small recesses (*see* paragraph **[0005]**) that are provided in the disclosure of the above-referenced application.

According to independent claims 1, 7, and 14, the rate of rotation of a substrate is "gradually" increased from a second speed to a third speed. Rodrigues provides a nonlimiting example of such gradual acceleration. Specifically, Rodrigues teaches that the rate at which a substrate is spun may be increased from a speed is 150-250 rpm to a speed of 800-1,500 rpm. Col 5, lines 27-30, and col. 6, lines 13-19. The acceleration outlined in Rodrigues is 100-500 rpm/sec, which yields a transition time in the neighborhood of 5 seconds. This transition time is one to two orders of magnitude slower, or about twenty to one hundred times

slower, than the 10,000 rpm/sec acceleration specified in Yoshihara, and about forty to two hundred times slower than the 20,000 rpm/sec "as quick as is practical" acceleration taught in Wolf. Thus, it would be apparent to one of ordinary skill in the art that Rodrigues provides an example of gradual acceleration, while the teachings of Yoshihara and Wolf are limited to acceleration which is not gradual.

It is, therefore, respectfully submitted that the meaning of the term "gradually," as it applies to acceleration of the rate at which a substrate is rotated, or spun, would be readily apparent to one of ordinary skill in the art of spin coating and in view of the prior art provided by the Office. Accordingly, it is respectfully submitted that each of claims 1, 7, and 14 complies with the definiteness requirement of the second paragraph of 35 U.S.C. § 112 and, thus, that each of these claims is in condition for allowance.

Withdrawal of the 35 U.S.C. § 112, second paragraph, rejections of claims 1, 7, and 14 is respectfully requested.

**Rejections Under 35 U.S.C. § 102**

Claims 1-4 stand rejected under 35 U.S.C. § 102(a) for reciting subject matter which is purportedly anticipated by that described in Yoshihara.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single reference which qualifies as prior art under 35 U.S.C. § 102. *Verdegaal Brothers v. Union Oil Co. of California*, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). The identical invention must be shown in as complete detail as is contained in the claim. *Richardson v. Suzuki Motor Co.*, 9 USPQ2d 1913, 1920 (Fed. Cir. 1989).

Independent claim 1, as proposed to be amended, recites a spin coating method in which a material is applied to a substrate, after which the material and substrate together are spun at a constant first speed, decelerated to a constant second speed, and finally accelerated to a constant third speed, which is faster than the first speed.

Yoshihara describes a resist coating method. Resist is applied to a substrate as the substrate is being rotated at a first speed, which is at or near 4,500 rpm (col. 10, line 5). The rate at which the substrate is rotated is then decreased for a predetermined period of time to the

moderate second speed of 2,000 rpm (col. 10, line 10). Thereafter, the rate at which the substrate is rotated is again increased to the moderately-high third speed of 3,000 rpm (col. 10, line 13). Yoshihara teaches that by spinning a semiconductor wafer at high speed, lowering the speed for a time, and re-increasing its rotational speed to moderately-high levels, the wafer can be coated with material in such a way that circular ripples do not appear thereon.

In Yoshihara, the third speed is less than the first speed. *See, e.g.,* col. 10, lines 5-13; Fig. 7A; Fig.10; claim 5. Specifically, Yoshihara teaches the following relationship: the first speed > the third speed > the second speed. *See id.*

It is respectfully submitted that amended independent claim 1 is further allowable since Yoshihara does not anticipate "gradually increasing a rate of spinning." As indicated in the tables of columns 9 and 10 of Yoshihara, the acceleration and deceleration between different spinning speeds are affected nearly instantaneously—at least 10,000 rpm/sec. For example, when the rate of spinning is increased from 2,000 rpm to 3,000 rpm, at an acceleration rate of 10,000 rpm/sec, as disclosed at col. 9, lines 55-62, the acceleration would be effected in 0.10 seconds. This rate of acceleration disclosed in Yoshihara is not gradual, as required by independent claim 1, but is "as quickly as is practical."

Yoshihara, therefore, does not anticipate each and every element of amended independent claim 1. Accordingly, it is respectfully submitted that, under 35 U.S.C. § 102(a), the subject matter recited in amended independent claim 1 is allowable over the subject matter described in Yoshihara.

Claims 2-4 are each allowable, among other reasons, for depending from claim 1, which is allowable.

Claim 2 is further allowable since Yoshihara lacks any express or inherent description that recesses in the substrate are substantially filled as the substrate is spun at a first speed. Instead, the disclosure of Yoshihara is limited to processes for reducing or eliminating the occurrence of ripples over the surface of a layer of material that has been applied to a substrate by spin coating processes.

Claim 3 is additionally allowance since Yoshihara neither expressly nor inherently describes that, as a rate at which a substrate is spun is decreased to a second speed, material

located within recesses of the substrate is permitted to set. Again, the description of Yoshihara is limited to spin coating processes which reduce or eliminate the occurrence of ripples on the surface of a material (*e.g.,* photoresist) layer.

For this reason, withdrawal of the 35 U.S.C. § 102(a) rejections of claims 1-4 is respectfully requested.

**Rejections Under 35 U.S.C. § 103(a)**

Claims 1-4, 7-11, 14-16, and 20-32 stand rejected under 35 U.S.C. § 103(a) for reciting subject matter which is assertedly unpatentable over that taught in Yoshihara in view of teachings from Rodrigues and Wolf.

The standard for establishing and maintaining a rejection under 35 U.S.C. § 103(a) is set forth in M.P.E.P. § 706.02(j), which provides:

> To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

The teachings of Yoshihara have been summarized above.

Rodrigues describes a method which includes spinning a semiconductor wafer at a very high first speed, decreasing the rate at which the wafer is spun to a very-low second speed while very slowly applying photoresist to the substrate during the deceleration phase (col. 4, lines 63-68), then, without maintaining the second rotational speed of the wafer once the material has been applied thereto, immediately increasing the rate at which the wafer is spun to a third speed which is much lower than the first speed (col. 6, lines 17-24), and further increasing the rate at which the wafer is spun to a fourth speed (col. 6, lines 48-54).

Rodrigues teaches that the spreading and shake-off phase of the process occurs when the wafer is spun at the third speed, between 800 and 1,500 rpm. In all possible embodiments of Rodrigues the third speed is much slower than the first speed, which may vary from 3,000 rpm to 7,000 rpm. Col. 5, lines 10-12.

Rodrigues references related prior art (col. 4, lines 6-13) which teaches a single speed process of dispensing resist onto a semiconductor wafer which is spinning at "a high rotational speed" and allowing the excess photoresist to be sloughed off and captured in a drain cup. While the fixed speed of rotation and amount of applied photoresist may be varied in the prior art (col. 1, lines 39-43), the lack of any variation in speed during the dispensing, spreading, and drying stages of the process precludes any applicability to the rejected claims.

As previously indicated, Wolf teaches a basic three stage process: (a) dispensing the resist solution on either a non-spinning wafer or a wafer spinning at very low speed (*e.g.,* 200 rpm), (b) accelerating the wafer at 20,000 rpm/sec to a final spin speed in the high speed (3,000 rpm) to very high speed (7,000 rpm) range, and (c) spinning the wafer at the final speed for 20-30 seconds to form and dry the resist film. Wolf, pg. 431.

It is respectfully submitted that the teachings of Yoshihara, Rodrigues, and Wolf, taken individually or collectively, do not support a *prima facie* case of obviousness against any of claims 1-4, 7-11, 14-16, or 20-32.

First, it is respectfully submitted that one of ordinary skill in the art would not have been motivated to combine the teachings of Yoshihara, Rodrigues, and Wolf in the manner that has been asserted. In particular, Wolf, at page 431, clearly teaches either a static (non-rotating) dispense or a dispense that takes place a very low speeds (200 rpm). Furthermore, the teaching of Wolf is that the "*static dispense* . . . provides more uniform coatings than if the wafer is rotating." This is in stark contrast to the teachings of Yoshihara and Rodrigues, which are limited to resist application techniques in which the resist is dispensed on a wafer while the wafer is rotating at high to very high speeds. Therefore, the portion of Wolf upon which the Office relies teaches away from the subject matter disclosed in both Yoshihara and Rodrigues and there would be no motivation to combine these references.

Moreover, by teaching that rotational acceleration or decelaration that is not "as quick as is practical" preserves a spun-on material (*see,* col. 5, line 33, to col. 6, line 15), Rodrigues teaches away from the "as quick as is practical" rotational acceleration and deceleration rates of Wolf and Yoshihara.

Therefore, without improperly relying upon the hindsight provided by the disclosure and claims of the above-referenced application, one of ordinary skill in the art would not have been motivated to combine the teachings of Yoshihara, Rodrigues, and Wolf in the manner that has been asserted.

Second, it is respectfully submitted that Yoshihara, Rodrigues, and Wolf do not, collectively or individually, teach or suggest each and every element of any of claims 1-4, 7-11, 14-16, or 20-32.

Independent claim 1, as proposed to be amended, is directed to a spin coating method which includes applying a material to a substrate, spinning the substrate and the material at a substantially constant first speed, then decreasing a rate of spinning to a substantially constant second speed, followed by gradually increasing a rate of spinning to a substantially constant third speed which is greater than the first speed.

Independent claim 7, as proposed to be amended, recites a spin coating method which includes applying a material to a substrate, spinning the substrate and the material at a first speed that permits the material to flow into recesses formed in the substrate, then spinning the substrate at a second speed that permits material within the recesses to set, and, thereafter, gradually increasing a rate at which the substrate is spun to a third speed which is greater than the first speed.

Independent claim 14, as proposed to be amended, is drawn to a spin coating method that includes applying a material to a substrate, spinning the substrate at a first speed to at least partially spread the material, then spinning the substrate at a second speed to permit at least some of the material to flow into at least on recess formed in the substrate, and, thereafter, gradually increasing a rate of spinning of the substrate to a third speed which is greater than the first speed.

Wolf only teaches the spinning at two speeds, 100 rpm and 3,000 rpm. Both Rodriques and Yoshihara teach the spinning of a substrate at a third speed, although neither of them teaches

that the third speed should be greater in value than the first speed. As previously noted, Yoshihara specifically claims that the third speed will be slower than the first speed, and the embodiments of Rodrigues outlined in the specification define a first speed which is always at least double the third speed. As Wolf does not teach or suggest the use of more than two speeds, and as neither Yoshihara nor Rodrigues teach or suggest that the third speed may be greater than the first speed, either expressly or implicitly, it is respectfully submitted that none of these references, taken either together or separately, teaches or suggests each and every element of any of amended independent claims 1, 7, or 14.

In view of the foregoing, it is clear that the teachings of Yoshihara, Rodrigues, and Wolf cannot be combined in such a way as to establish a *prima facie* case of obviousness against any of claims 1, 7, or 14. Thus, under 35 U.S.C. § 103(a), the subject matter recited in each of these claims is allowable over the combined teachings of Yoshihara, Rodrigues, and Wolf. Claims 2-4 and 21-24 are each allowable, among other reasons, as depending either directly or indirectly from claim 1, which is allowable.

Each of claims 8-11 and 25-28 is allowable, among other reasons, for depending either directly or indirectly from claim 7, which is allowable.

Claims 15, 16, 20, and 29-32 are each allowable, among other reasons, as depending directly or indirectly from claim 14, which is allowable.

In view of the foregoing, it is clear that the teachings of Yoshihara, Rodrigues, and Wolf cannot be combined in such a way as to establish a *prima facie* case of obviousness against any of claims 1-4, 7-11, 14-16, or 20-32. Thus, under 35 U.S.C. § 103(a), the subject matter recited in each of these claims is allowable over the separate or combined teachings of Yoshihara, Rodrigues, and Wolf.

It is respectfully requested that the 35 U.S.C. § 103(a) rejections of claims 1-4, 7-11, 14-16, 20-32 be withdrawn.

**Entry of Amendments**

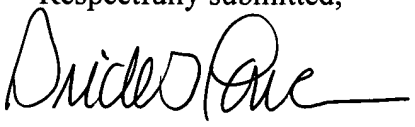
It is respectfully requested that the proposed claim amendments be entered. The proposed amendments do not introduce new matter into the application, nor would they require an

additional search. In the event that a decision is made not to enter the proposed claim amendments, entry thereof upon the filing of a Notice of Appeal in the above-referenced application is respectfully requested.

## CONCLUSION

It is respectfully submitted that each of claims 1-4, 7-11, 14-16, and 20-32 is allowable. An early notice of the allow ability of each of these claims is respectfully solicited, as is an indication that the above-referenced application has been passed for issuance. If any issues preventing allowance of the above-referenced application remain which might be resolved by way of a telephone conference, the Office is kindly invited to contact the undersigned attorney.

Respectfully submitted,



Brick G. Power
Registration No. 38,581
Attorney for Applicants
TRASKBRITT, PC
P.O. Box 2550
Salt Lake City, Utah 84110-2550
Telephone: 801-532-1922

Date: September 7, 2005
BGP/dp:eg
Document in ProLaw